HE GYPSY MOTH

A THREAT TO SOUTHERN FORESTS

U.S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE
SOUTHEASTERN AREA, STATE & PRIVATE FORESTRY
ENVIRONMENTAL PROTECTION AND IMPROVEMENT
Forest Pest Management

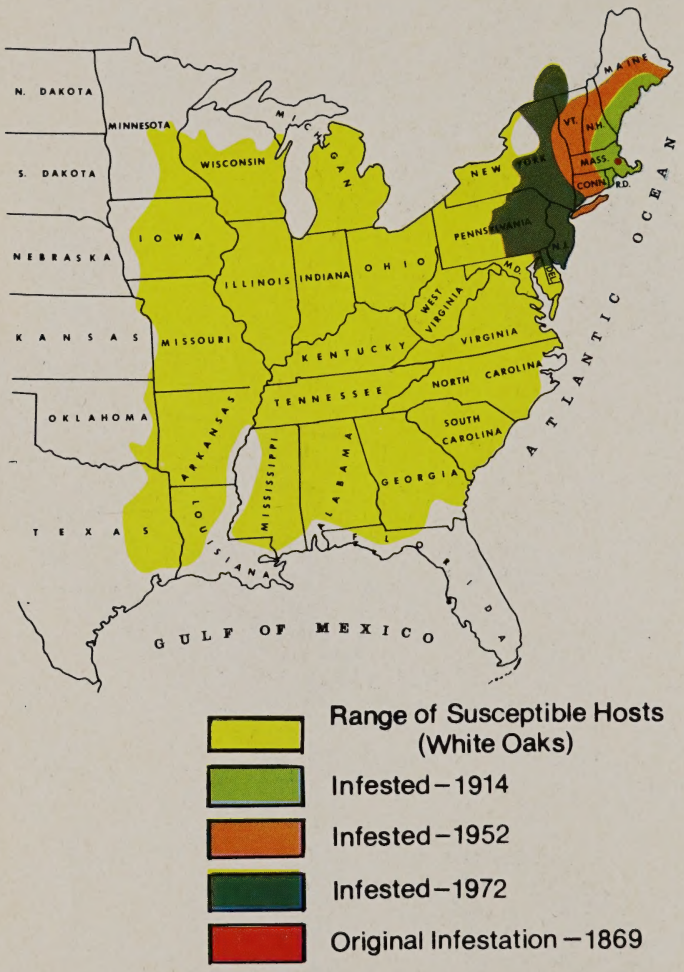

Figure 1. Chronological spread of the gypsy moth infestation and the distribution of susceptible hosts (after USDA, 1972).

THE GYPSY MOTH

Threat to Southern Forests

*Prepared by Dr. Kenneth H. Knauer**

INTRODUCTION & HISTORY

The gypsy moth, *Porthetria dispar* (L.), is a forest insect native to Europe and Asia. In 1869 a French biologist introduced gypsy moth eggs into Medford, Massachusetts. His intention was to cross the gypsy moth with the silkworm moth to obtain a hardy race of silk-producing moths. Escaped larvae from the Medford experiments are responsible for the current gypsy moth infestation in the northeastern United States.

The gypsy moth became so numerous in Medford and surrounding areas by 1889 that in 1890 the Commonwealth of Massachusetts undertook steps to eradicate the pest. This effort resulted in the first law in the United States for extermination of an insect and set up legal authority permitting entry onto private property for that purpose. The Federal government became active in cooperative regulations in 1912 to retard further spread when the insect became an interstate problem.

During the years the gypsy moth has been in this country it has spread over 200 thousand square miles, defoliating forest and ornamental trees (Figure 1). This insect is now established in all or portions of eleven states in the Northeast from Maine to eastern Pennsylvania, eastern Maryland, and Northern Delaware. The gypsy moth is also established in southern Ontario and Quebec Provinces, Canada.

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GYPSY MOTH LIFE HISTORY AND BEHAVIOR

The gypsy moth is similar to all moths in having four life stages: egg, larva (caterpillar), pupa (resting stage), and adult (Figure 2). The damage is caused by the removal of foliage by feeding caterpillars. The adult male is a slender-bodied, dark brown moth with black bands across the forewings. He is a strong flier and has conspicuous feather-like antennae which aid in locating a female. The heavier-bodied female moth is nearly white with wavy black bands across the forewings. Her abdomen is clothed in buff-colored hairs. The female gypsy moth has a wing-span of about 2 inches but is not often observed flying.

The mature gypsy moth caterpillar is from 1-1/2 to 2-1/2 inches long and has yellow markings on its head. The most distinctive feature about this hairy caterpillar is the double row of 5 pairs of blue spots followed by 6 pairs of red spots down its back. The resting stage between the larva and the adult moth, called the pupa, is usually dark, reddish brown. Female pupae are usually much larger than male pupae (Craighead, 1949).

In the Northeast the gypsy moth has one generation per year and overwinters in the egg stage. Depending upon the weather, eggs begin hatching in late April or early May (Figure 3). Newly hatched larvae, responding to light, climb up into the tree crowns. The first instar larvae is the natural dispersal stage of the gypsy moth. Under certain conditions of temperature and humidity, gusts of wind stimulate the newly hatched caterpillars to drop from the foliage on silk threads. When the wind stops the larvae climb back up the threads. Continuous or strong, gusty winds, however, snap the threads and the small caterpillars, light weight and covered with long, fine hairs, are easily blown away.

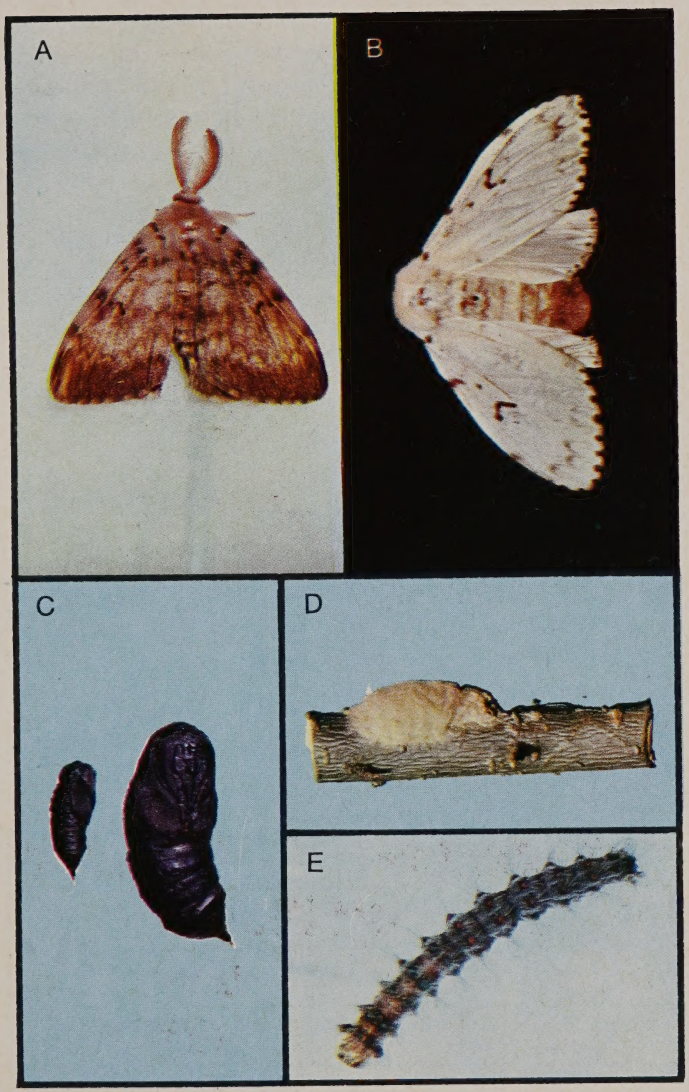

Figure 2. Gypsy moth life stages: A. adult male; B. adult female; C. male and female (right) pupae; D. egg mass; E. full-grown larva. All about natural size.

Many of the small larvae perish when they drop onto unacceptable hosts or areas with no vegetation. Some, however, will drop onto acceptable host trees in sufficient numbers to establish a new infestation or to replace larvae previously dispersed from an established infestation.

As the caterpillars mature, a shift in their feeding behavior occurs. Previously feeding by day, they now feed during the night. At daybreak they climb down the tree to find resting places under bark flaps or in the litter on the forest floor. Competition for feeding and resting sites in heavily infested areas, however, may force the larvae to continue feeding into the daylight hours. About 70 percent of the total foliage eaten by a single larva is consumed during the last larval instar.

Gypsy moth larvae pass through five and six instars for the males and females, respectively. Caterpillars reach full size in late June or early July and enter the pupal stage. The pupal stage usually lasts from 10 to 17 days. Adult male moths emerge from their pupal cases several days prior to female emergence. Unmated females attract males with a powerful sex lure.

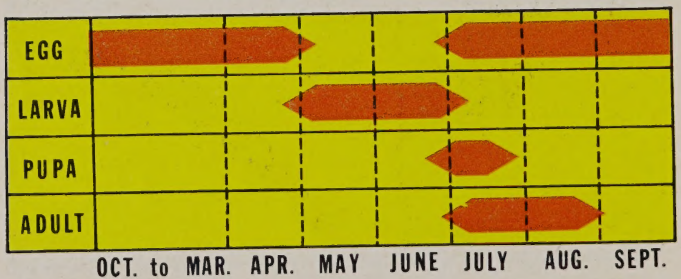

Figure 3. Life cycle of the gypsy moth in the Northeast (after Nichols, 1961)

Shortly after the females have mated, they begin depositing masses of 100 to 800 or more eggs. The female generally lays her eggs close to the place where she emerged from her pupal shell. Eggs may be deposited on any surface: on trees, under rocks, on houses, and on the undersides of house trailers or campers. The egg mass is covered with buff colored hairs from the female's body (Figure 4). Adult moths take no food and die soon after completion of their reproductive function (Nichols, 1961).

Figure 4. Female gypsy moth depositing egg mass. Egg mass is covered with hairs from the female's body.

The preferred hosts of the gypsy moth are apple, alder, aspen, beech, basswood, gray and river birch, hawthorn, oak, and willow. Larvae will also feed on other birches, cherry, elm, blackgum, hickory, hornbeam, larch, maple, and sassafras. Older larvae can feed successfully on hemlock, cedar, pine, and spruce. Those species which are not favored by

the gypsy moth larvae include ash, balsam, fir, butternut, black walnut, catalpa, red cedar, dogwood, holly, locust, sycamore, and yellow-poplar (Mosher, 1915).

Conifers such as hemlock and white pine may be killed by one complete defoliation. Hardwood species may be killed by two successive years of defoliation. In most cases, one defoliation weakens the tree making it susceptible to secondary attack by other insects or diseases.

Hardwood stands in the Northeast vary in their susceptibility to gypsy moth population build-up, defoliation, and damage. Stands containing less than 50 percent of preferred host species generally sustain little mortality. Stands on moist sites are also less susceptible to damage than are those on wet or dry sites (Campbell, 1970; Bess, et al., 1947). Vertebrate predators, such as mice, are favored by habitat conditions on moist sites and help reduce gypsy moth infestation levels by feeding on the larvae and pupae.

AGENCY RESPONSIBILITIES AND STATUS

The U.S. Department of Agriculture has four agencies involved in coordination of the Federal-State gypsy moth program. The agencies are: Animal and plant Health Inspection Service (APHIS), Agricultural Research Service (ARS), Extension Service, and Forest Service. The five major areas of the USDA gypsy moth program include: 1) Regulatory; 2) Survey; 3) Evaluation and Suppression; 4) Research; and, 5) Information and Education.

Under the terms of the Federal Plant Quarantine Act of August 20, 1912, and its revisions, shipment of all nursery stock, forest products, and quarry products originating within the infested area is

regulated. The responsibility for enforcing the quarantine belongs to the Animal and Plant Health Inspection Service, Plant Protection and Quarantine Programs. The objectives of the regulatory program are to minimize artificial spread of the gypsy moth from infested to non-infested areas.

Detection survey responsibilities are shared by APHIS, the Forest Service, and various State agencies. The States and the Forest Service assess the extent of defoliation and evaluate infestation trends. APHIS is particularly concerned with the potential long distance spread of the moth. Egg mass surveys in the winter and male moth trap surveys during the summer in the infested region help locate areas where the potential is high for artificial spread by mobile homes and recreational vehicles. Traps are also used in the non-infested areas to check the rate of moth spread and locate new infestations.

The movement of mobile homes and recreation vehicles out of the generally infested area is a significant threat to the containment of long-range gypsy moth spread. These vehicles may carry gypsy moth larvae, pupae, or egg masses into uninfested regions of the country. The majority of the counties in which male moths are trapped for the first time are along major travel arteries or scenic vacation routes.

The Animal and Plant Health Inspection Service and the Division of Forest Pest Control, U.S. Forest Service, have separate but complementary responsibilities regarding gypsy moth suppression. APHIS retains the responsibility for enforcing the Federal quarantine. They also participate in cooperative control activities with State agencies when a gypsy moth infestation occurs where a high potential for long-distance spread exists. The Forest Service enters into cooperative pest control agreements

with State agencies when the forest resource is threatened. Suppression decisions are based on a biological evaluation, a benefit/cost analysis, and environmental impact considerations to determine the need for control. The APHIS suppression effort is concentrated in campgrounds, mobile home parks, and spot infestations located ahead of the leading edge of the generally infested area.

The Forest Service, ARS, and APHIS have specific but coordinated research responsibilities. The Forest Service conducts research on gypsy moth biology and ecology in order to develop pest management systems. ARS is responsible for the importation and screening of foreign parasites and predators. APHIS emphasizes investigations in parasite and predator rearing and release, pesticide screening, and regulatory treatment improvement. The USDA also funds cooperative agreements and research grants at universities and private research laboratories.

The Extension Service, aided by personnel from the other three USDA agencies, coordinates the gypsy moth education and information activities for USDA.

THREAT TO SOUTHERN FOREST RESOURCES

The gypsy moth threat to southern forest resources has been discussed by individuals and agencies for the past 40 years. On the basis of host presence, the gypsy moth could become established in the entire region in which oaks, preferred hosts, are a major component of the forest stands (Perry, 1955). The current unanswerable question is: What will be the impact? The milder climate in the South is expected to hasten gypsy moth development. As the insect moves south, it is possible that egg hatch could occur earlier in the spring. Larval development time might also decrease slightly. The gypsy moth does not have a second generation in southern

Europe or North Africa but the development of a second generation in the South remains a remote possibility.

Arguments suggesting a less severe gypsy moth impact refer to the diverse species composition of southern hardwood forests (the greater the percentage of non-host species the greater the stand resistance to the gypsy moth). Unfortunately, little is known about the susceptibility of either the southern hardwoods or the southern yellow pines. Gypsy moth larvae have been reared to maturity on white pine and sometimes the older larvae, under intense population pressure, do feed on pitch pine. Infestations are being studied in the mid-Atlantic States to assess the feeding intensity and success on shortleaf and Virginia pines.

Timber is not the only forest resource threatened by the gypsy moth. The increasing popularity of the southern Appalachian Mountains for recreation makes a hardwood-forested mountainside a valuable asset. The tourist industry in this region may temporarily be affected following a gypsy moth infestation.

Commonly, during the first three to five years after the introduction of the gypsy moth into a new area, the insects become generally distributed at low densities. At this time the moths are only occasionally locally abundant. Following establishment, a population explosion may occur throughout the entire area for two or more years in succession. Eventually, as competition for food, predators, parasites, and weather factors increase stresses on the population, susceptibility to the gypsy moth virus wilt disease also increases and population collapse occurs.

The dilemma of what action to take regarding a gypsy moth invasion occurs during the population explosion

period. The most biologically expedient action would be to permit the insect to become established, sit out the explosion, and then rely on biological controls to keep the populations at low levels. Chemical control would be employed only in high-hazard, high-resource-value areas. The conflict here, of course, is that during the explosion phase extensive hardwood acreage might be defoliated. Chemical pesticide applications over large areas, however, could prolong the explosion phase by reducing competition and by destroying the predators and parasites. If the area treated is extensive, repeated elimination of the gypsy moth retards establishment of biological control agents. Suppression decisions must be made with long-range as well as short-range benefits taken into consideration.

PROSPECTS FOR SUPPRESSION

Difficulties in suppressing the gypsy moth relate directly to the fact that this insect is an introduced pest. When the first gypsy moth was introduced into this country its natural enemies were left behind in Europe and Asia. Reduced pressure from parasites and predators, and an abundant host supply, contributed significantly to the gypsy moth's successful establishment. A similar situation occurs as the gypsy moth moves south and west in this country. Natural enemies are initially left behind in the infested areas in the North, unavailable to influence the population explosion which generally accompanies the establishment of an insect pest in a new area.

Since the early 1900's the U.S. Department of Agriculture has been engaged in collecting, screening, rearing, and releasing natural enemies of the gypsy moth. Before the advent of relatively inexpensive chemical insecticides, mechanical and less efficient chemical means were used to suppress

gypsy moth populations. These methods were complemented by releases of imported gypsy moth parasites and predators. Thus far, eight parasites and one predator important in gypsy moth population reduction have become established in the Northeast. Many more have either failed to become established or are not considered effective. It is estimated that as many as 77 parasites and predators from Europe and Asia have yet to be screened for release in this country. Continued emphasis on biological control is an important aspect of gypsy moth suppression in the future. Parasites and predators alone, however, will not provide the solution.

The threatened invasion of the South by the gypsy moth has already been attributed to increased mobile home and travel trailer traffic. The buildup occurring in the Northeast is supplying the moths for the invasion.

Today, scientists are attempting to discover overlooked parasites and predators, develop strains of insect-killing bacteria and viruses, locate environmentally acceptable insecticides, isolate the inhibitor that keeps gypsy moth larvae from feeding on some hardwood species, and use a synthetic sex attractant in trap-out or confusant strategies. The ultimate objective is to put together an integrated suppression system which uses all of the successful tools available.

SUMMARY

The southward dispersal of the gypsy moth is considered to be an established and inevitable fact. The exact magnitude of the impact cannot be foreseen at this time. The absence of natural enemies and the abundance of suitable hosts assure that the upland hardwood resource in the South is in some danger.

It is not ecologically desirable or permissible to undertake large-scale chemical insecticide spray programs for insect suppression. Research sponsored by the U.S. Department of Agriculture, State agencies, and Universities is striving to provide acceptable and effective mechanisms for treating gypsy moth infestations. It must be remembered, however, that the gypsy moth is just one of scores of native and introduced tree pests. The value of the threatened resource should be the most important factor in evaluating the need for action.

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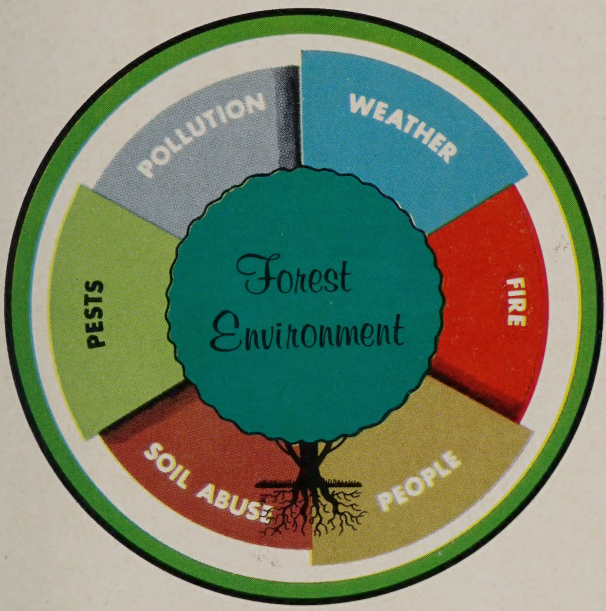

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